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## **Dermoscopic evaluation of skin in healthy cats**

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**Abstract:** **BACKGROUND:** Dermoscopy is a diagnostic tool that can reveal morphological structures not visible upon clinical examination. **HYPOTHESIS/OBJECTIVES:** To assess the usefulness and applicability of dermoscopy for the examination of healthy cat skin. **ANIMALS:** Twenty-one domestic short-haired cats from a feline rescue association. **METHODS:** Four regions (head, dorsal neck, sacral and abdominal regions) were examined with both a contact hand-held nonpolarized light dermoscope at 10-fold magnification and a videodermoscope at 70-fold magnification. Findings were assessed using histological analysis of skin samples cut both longitudinally and transversely, set as the gold standard. **RESULTS:** With a hand-held dermoscope at 10-fold magnification, thick, straight primary hairs surrounded by multiple secondary hairs were observed. With a videodermoscope at 70-fold magnification, hair shaft thickness was measured and the follicular openings and arrangement of vessels were clearly observed. Correspondence was observed between dermoscopic and histological results. **CONCLUSIONS AND CLINICAL IMPORTANCE:** Dermoscopy represents a valid noninvasive and reproducible technique that could be helpful in clinical examination.

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# Dermoscopic evaluation of skin in healthy cats

## Abstract

**Background** – Dermoscopy represents a diagnostic tool that by revealing morphologic structures not visible to the naked eye has improved cutaneous clinical examination.

**Objectives** – To assess the usefulness and applicability of dermoscopy for skin examination of clinically healthy cats.

**Animals** – Twenty-one DSH cats from a feline rescue association.

**Methods** – Four regions (frontal, dorsal neck, sacral, and abdomen) were selected and dermoscopy was performed with both a contact handheld non-polarized light dermoscope at 10-fold magnification and a videodermoscope at 70-fold magnification. Findings were assessed using histomorphometric analysis of skin samples cut both longitudinally and transversely, set as gold standard.

**Results** – With handheld dermoscopy at 10-fold magnification, thick, straight primary hairs surrounded by multiple secondary hairs were observed on translucent skin. With videodermoscopy at 70-fold magnification, hair shaft thickness was measured and the follicular openings and arrangement of vessels were clearly observed. Correspondence was observed between dermoscopic and histologic results.

**Conclusions** – Dermoscopy represents a valid noninvasive and reproducible techniques that may open new perspectives in veterinary dermatology by improving diagnostic accuracy in several clinical scenarios.

## Introduction

Mammalian skin is both the largest organ of the body and a physiologic barrier between the animal and environment. A great deal of information on dermatologic conditions can be obtained by microscopically studying materials collected from hair and skin. For this purpose, several easy-to-perform techniques can be used to add valuable information to a case workup.<sup>1</sup>

In recent decades, there has been growing use of new diagnostic tools in the dermatology field, mostly in humans. The introduction of dermoscopy, for example, has provided additional morphologic information during clinical examination by revealing cutaneous structures invisible to the naked eye.<sup>2-4</sup> In practice, this technique relies on direct contact of an optical handheld lens with the skin surface and on visualization of skin structures at 10-fold magnification.<sup>5</sup> However, digital videodermoscopes that allow fine observation of skin details by exploiting magnification from 20- to 100-fold and higher have recently emerged.<sup>6</sup> Although dermoscopic diagnostic accuracy has been documented, mostly in the clinical evaluation of pigmented skin tumors,<sup>7-9</sup> in recent years this technique has been employed for the evaluation of morphologic vascular patterns, hair and follicular abnormalities,<sup>4,10</sup> and for several inflammatory and infectious skin diseases.<sup>11</sup> To the authors' knowledge, except for an abstract regarding the dermoscopic features of dermatophytosis in cats by means of a handheld lens,<sup>12</sup> no studies have been documented on the application of this diagnostic tool in veterinary dermatology. Against this background, our objectives were to describe the dermoscopic features of healthy feline skin and to assess the correspondence between dermoscopic and histologic findings. We focused on the possibility of reaping the rewards of new non-invasive and reproducible techniques and opening new perspectives in the everyday practice of the clinician in veterinary dermatology.

## Materials and Methods

*Study population:* Twenty-one domestic short-haired cats from a feline rescue association were enrolled in this study. This group included 2 intact females, 9 spayed females, and 10 neutered males, ranging in age from 1 to 6 years (mean  $\pm$  SD=  $2.7 \pm 1.8$ ) and in body weight from 1.9 to 6 kg (mean  $\pm$  SD=  $3.1 \pm 1.0$ ). Cats were considered healthy on the basis of normal results on physical examination, complete blood count, and routine serum biochemical analysis. To avoid artifacts derived from movement, cats were sedated with a dexmedetomidine (Dexdomitor®)/ketamine (Imalgene®) combination at 10  $\mu$ g/kg and 3 mg/kg, respectively. Once positioned in sternal recumbency, three regions were selected for the first examination, in the following order: frontal halfway along the line connecting the rostral margins of the supraorbital processes, dorsal neck at the junction between the second and third cervical vertebrae, and sacral halfway along the line connecting the right and left tuber coxae. Cats were then positioned in dorsal recumbency and the abdominal region along the linea alba was the fourth selected region. In all these regions, areas of 2 cm x 4 cm were gently clipped. All procedures outlined in this study were approved by the feline rescue association after submission of information and were performed under good clinical practices in accordance with ethical guidance published in no. 289 of the national Gazzetta Ufficiale (G.U.), 10 December 1996, 47-53.

*Dermoscopic examination:* A contact handheld non-polarized light dermoscope (Heine Delta 20® Plus, HEINE Optotechnik GmbH & Co. KG, Germany) with immersion fluid (gel) was applied to the above-selected regions, and to ensure consistency of resolution and illumination, images at 10-fold magnification were acquired consecutively with a digital camera (Nikon D3100, Nikon USA Inc, Melville, NY) directly connected to the dermoscope. Dermoscopic examination was also performed with a videodermoscope (FotoFinder Systems GmbH, Bad. Birnbach, Germany), and 70-fold magnification was selected to better visualize cutaneous details. Indeed, at this magnification and based on gross appearance, both primary and secondary hairs were observed, hair thickness was measured in direct proximity to the follicular ostia, and arrangement of vascular structures was evaluated.

*Histologic examination:* skin samples from selected regions were taken with a 6 mm punch biopsy and placed in neutral-buffered 10% formalin for 48-72 hours at 4°C. After dehydration in a graded series of ethanol, tissue blocks were embedded in paraffin. Sections (4-6  $\mu$ m thick), cut both longitudinally and transversely, were stained with haematoxylin and eosin for histological examination. Sections were then observed and photographed under an Olympus BX51 photomicroscope equipped with a digital camera, and DP software (Olympus, Italy) was used for computer-assisted image acquisition and management. Histometric measurements of skin thickness were taken.

## Results

*Dermoscopic features:* With handheld dermoscopy at 10-fold magnification, thick, straight primary hairs surrounded by multiple secondary hairs were dorsally observed (Figure 1a). Ventrally, thinner hairs were far more numerous. The infundibular portion of the hair follicles and interfollicular skin appeared whitish and translucent. With

videodermoscopy at 70-fold magnification, thick hairs emerging independently through an individual external orifice and considered as guard hairs were observed dorsally. Guard hairs were surrounded by three to four fine, slightly crimped hairs considered as down hairs, all emerging through a common external orifice. Hairs thicker than down hairs but thinner than guard hairs were also detected and considered as awn hairs. Thin arborizing vessels between follicular units were observed. All these findings and measurements of hair thickness are shown in Figure 2a. Ventrally, guard hairs and numerous down hairs were detected at 70-fold magnification (Figure 2c).

**Histologic features:** In transverse histological sections taken dorsally, hair follicle units typically comprised three compound hair follicles, showing a characteristic spatial arrangement. Centrally, a large primary hair follicle was present. The two compound hair follicles on each side of the central hair had a lateral primary hair follicle surrounded by three or four secondary hair follicles (Figure 1b, 2b). Ventrally, up to 14-16 secondary hair follicles surrounded the primary hair follicle (Figure 2d). Superficial dermal vessels were also observed as normal (Figure 2d).

## Discussion

In humans, noninvasive *in vivo* imaging techniques have become an important diagnostic aid for clinicians. Dermoscopy, also known as dermatoscopy, incident light microscopy, skin surface microscopy, and epiluminescent microscopy, provides clinicians experienced in the technique with additional information on the morphology of skin lesions.<sup>3,4</sup> However, although a dermoscope is functionally similar to a magnifying lens, it is, rather, a more complex instrument with the added features of an inbuilt illuminating system, greater magnification, and the ability to assess skin structures and record images.<sup>13</sup> There are many types of dermoscopes, conventionally divided into handheld types with a 10-fold magnification and digital types, equipped with software which allow measurement of the visualized structures in images magnified up to 70-fold, and which yield results in real scale. Dermoscopy examination can be done with a non-polarized (NPD) or a polarized (PD) light source. The former requires application of a liquid such as water, oil, or alcohol-gel at the interface between the epidermis and the glass slide of the device, optically linking to the *stratum corneum* and reducing the light reflection responsible for the glistening appearance of the skin surface.<sup>5</sup> With this method, structures present below the skin surface such as melanin and blood vessels may be observed.<sup>4,10,14</sup> Conversely, PD is usually created with the use of filters without the necessity of a liquid interface, superficially blocking reflected light more efficiently than NPD. However, while it is generally thought that NPD and PD are similar, the dermoscopic images obtained are not equivalent, but rather complementary.<sup>5,15-17</sup> In humans, these dermoscopes can also be used for hair and scalp examination, known as trichoscopy.<sup>10,18-20</sup> Nevertheless, in healthy individuals, trichoscopy has not been extensively studied and what has been published has focused mostly on the appearance of hair shafts, follicular openings, and blood vessels.<sup>21,22</sup> Against this background, our purpose was to test, in veterinary dermatology, the use of dermoscopy in healthy cats, in order to describe hair shaft characteristics, follicular openings, and vascular arrangements, so as to contribute to improving diagnostic accuracy and to laying the foundations for further studies. We used both handheld NPD and videodermoscope and at 10-fold magnification it was possible to clearly

distinguish primary from secondary hairs and to visualize the hair follicle infundibula and the interfollicular skin. Contrary to humans, blood vessels were not visible at this magnification in the interfollicular skin. Nevertheless, with videodermoscope at 70-fold magnification, it was possible to measure the diameter of hairs and to observe the follicular openings and other details such as vessels between follicular units. On translucent skin, guard hairs appeared thicker and straight when compared with the thinner awn and down hairs. Guard hairs were clearly observed as they emerged individually from an external orifice, in contrast with the down hairs emerging all together from a common external orifice. Capillary loops under the translucent epidermis and believed to emanate from the superficial plexus to supply the epidermis and upper portion of the hair follicles were also observed between follicular units, as a normal finding, just as reported in humans.<sup>23</sup> Although similar results were also demonstrated between dermoscopic and histological features, histological examination not always allows to fully appreciate the morphologic features of vessels as normally provides a vertical view of skin sections. Dermoscopy by contrast, through a horizontal view of the skin, enables the identification of vessels that run parallel to the skin and their architectural arrangement. Moreover by dermoscopy and in comparison with histology, it is possible to better appreciate the perifollicular contour and the interfollicular skin in addition to the measurement of relevant trichologic structures. All these observations and practical clinical indications of dermoscopy are summarized in the table 1. It can be concluded that dermoscopy is a reliable diagnostic tool and in the future, it is expected that it could become a useful diagnostic technique for establishing hallmark features also in feline skin disorders.

## References

1. Miller WH, Griffin CE, Campbell KL. Structure and function of the skin. In: Miller WH, Griffin CE, Campbell KL, eds. Muller and Kirk's Small Animal Dermatology. 7th edition. Philadelphia, PA: W.B. Saunders Co., 2013; 1-56.
2. Zalaudek I, Argenziano G, Di Stefani A *et al.* Dermatoscopy in general dermatology. *Dermatology* 2006; 212: 7-18.
3. Micali G, Lacarrubba F, Massimino D *et al.* Dermoscopy: alternative uses in daily clinical practice. *J Am Acad Dermatol* 2011; 64: 1135-46.
4. Lallas A, Zalaudek I, Argenziano G *et al.* Dermoscopy in general dermatology. *Dermatol Clin* 2013; 31: 679-94.
5. Benvenuto-Andrade C, Dusza SW, Agero AL *et al.* Differences between polarized light dermoscopy and immersion contact dermoscopy for the evaluation of skin lesions. *Arch Dermatol* 2007; 143: 329-38.
6. Rudnicka L, Olszewska M, Rakowska A. Atlas of Trichoscopy. Dermoscopy in hair and scalp disease. Rudnicka L, Olszewska M, Rakowska A, eds. Springer-Verlag London, 2012.
7. Argenziano G, Puig S, Zalaudek I *et al.* Dermoscopy improves accuracy of primary care physicians to triage lesions suggestive of skin cancer. *J Clin Oncol* 2006; 24: 1877-82.
8. Argenziano G, Albertini G, Castagnetti F *et al.* Early diagnosis of melanoma: what is the impact of dermoscopy? *Dermatol Ther* 2012; 25: 403-9.
9. Menzies SW. Evidence-based dermoscopy. *Dermatol Clin* 2013; 31: 521-4.
10. Miteva and A.Tosti. Hair and scalp dermatoscopy. *J Am Acad Dermatol* 2012; 67: 1040-8.

11. Lallas A, Giacomel J, Argenziano G *et al*. Dermoscopy in general dermatology: practical tips for the clinician. *Br J Dermatol* 2014; 170: 514-26.
12. Scarpella F, Zanna G, Peano A *et al*. Dermoscopic features of dermatophytosis of 11 cats with *microsporum canis* infection. *Vet Derm* 2013; 24: 393 (abstract).
13. Nischal KC, Khopkar U. Dermoscope. *Indian J Dermatol Venereol Leprol* 2005; 71: 300-3.
14. Martín JM, Bella-Navarro R, Jordá E. Vascular patterns in dermoscopy. *Actas Dermosifiliogr* 2012; 103:357-75.
15. Anderson RR. Polarized light examination and photography of the skin. *Arch Dermatol* 1991; 127: 1000-5.
16. Gewirtzman AJ, Saurat JH, Braun RP. An evaluation of dermoscopy fluids and application techniques. *Br J Dermatol* 2003; 149: 59-63.
17. Wang SQ, Dusza SW, Scope A *et al*. Differences in dermoscopic images from nonpolarized dermoscope and polarized dermoscope influence the diagnostic accuracy and confidence level: a pilot study. *Dermatol Surg* 2008; 34: 1389-95.
18. Rudnicka L, Rakowska A, Kerzeja M *et al*. Hair shafts in trichoscopy: clues for diagnosis of hair and scalp diseases. *Dermatol Clin* 2013; 31: 695-708.
19. Rudnicka L, Rakowska A, Olszewska M. Trichoscopy: how it may help the clinician. *Dermatol Clin* 2013; 31: 29:41.
20. Rudnicka L, Olszewska M, Rakowska A *et al*. Trichoscopy: a new method for diagnosing hair loss. *J Drugs Dermatol* 2008; 7: 651-4.
21. Rakowska A. Trichoscopy (hair and scalp videodermoscopy) in the healthy female. Method standardization and norms for measurable parameters. *J Dermatol Case Rep* 2009; 3: 14-9.
22. Fu JM, Starace M, Tosti A. A new dermoscopic finding in healthy children. *Arch Dermatol* 2009; 145: 596-7.
23. Ross EK, Vincenzi C, Tosti A. Videodermoscopy in the evaluation of hair and scalp disorders. *J Am Acad Dermatol* 2006; 55: 799-806.

## Figure legends

**Figure 1.** Comparison between dermoscopic findings (a) and haematoxylin and eosin-stained transversal section of a corresponding area of cat skin . At 10-fold magnification with a handheld non-polarized dermoscope in dorsal neck region, numerous primary hairs (yellow asterisk) are surrounded by secondary hairs (white asterisk) on translucent skin (scale represents 1 cm) (a). Histology of a similar area shows a regular repetition of hair follicle units arranged in groups of three compound hair follicles, with one *arrector pili* muscle each. Central primary hair follicle (cPHF) and secondary hair follicles (SHF) (scale bar represents 1000 µm; 4x) (b).

**Figure 2.** Comparison between videodermoscopic findings (a) and haematoxylin and eosin-stained transversal section of a corresponding area of cat skin. Videodermoscopic findings at 70-fold magnification: On a scale of 20.03 mm: primary hairs=0.95 mm and 1.46 mm; secondary hairs=0.24 mm. Arborizing blood vessels can also be observed (circle) (scale bar represents 20 mm) (a). At higher magnification, histology of a similar area shows a large central primary hair follicle

(cPHF), with two compound hair follicles on each side, each of them composed of a lateral primary hair follicle (IPHF), thinner than the guard hair, surrounded by four or five secondary hair follicles (SHF). Normal blood vessels (BV) are present (arrow) (scale bar represents 200  $\mu$ m; 20x) (b). Numerous secondary hairs in ventral region (70-fold) and their thickness (mm) (on a scale of 1 mm, hair thickness=0.02 mm and 0.03 mm) (c). Histology of a similar areas shows numerous secondary hair follicles (SHF) (scale bar represents 200  $\mu$ m 10x) (d).

**Table 1.** Skin features that may be visualized by dermoscopy and possible applications of dermoscopy in veterinary dermatology.

What to observe dermoscopically			
Hair shafts	Hair follicle openings	Perifollicular and interfollicular skin surface	Blood vessels
Type and number of hairs in the follicular units	Presence of hair shaft residues, follicular plugs	Scaling intensity and location	Morphology of vascular patterns
Assessment of hair shaft components	Size	Surface structures	Arrangement of vascular structures
Hair shaft thickness (videodermoscopy)	Color	Color	Color
Possible clinical indications for dermoscopy			
Identification of: <ul style="list-style-type: none"> <li>Parasites (es. lice adults and their eggs, <i>Cheyletiella</i> spp)</li> <li>Hair shaft structure abnormalities</li> <li>Hair density abnormalities</li> <li>Hair pigmentation abnormalities</li> <li>Hair cycling abnormalities</li> </ul>	<ul style="list-style-type: none"> <li>Identification of:               <ul style="list-style-type: none"> <li>Parasites (es. <i>Demodex</i> spp)</li> <li>Follicular keratosis</li> <li>Different pattern of follicular scales</li> </ul> </li> </ul>	Identification of: <ul style="list-style-type: none"> <li>Parasites (es. <i>Cheyletiella</i> spp)</li> <li>Perifollicular inflammation</li> <li>Interfollicular inflammation</li> <li>Different patterns and colors of scaling</li> <li>Skin color variegations</li> <li>Discharge</li> <li>Surface structures</li> </ul>	Identification of alternative vascular patterns as indicator for diseases